"The ^{56}Ni(^{3}He,p) reaction and the question of T=0, T=1 pairing in N=Z nuclei"

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Our previous analysis of both pairing vibrational spectra near ^{56}Ni and binding energy differences in N=Z provided strong evidence for collective T=1 *np* pair correlations, but showed no evidence for collective T=0 pairing [1,2], contrary to theoretical expectations. Whether T=0 pairing exists is still one of the unanswered important questions in nuclear structure and additional experimental tests are required. Two nucleon transfer reactions are a sensitive probe of pair correlations and in particular (^{3}He,p) reactions in even-even N=Z nuclei could provide a unique fingerprint of *np* pairing. We proposed to study the reaction ^{56}Ni(^{3}He,p) at the ATLAS facility at ANL to confirm the conclusions from our previous analysis.

The work proceeded in two steps. First we carried out a series of measurements to study the (^{3}He,p) reaction in reverse kinematics, using the stable beams of ^{28}Si, ^{32}S, ^{36}Ar, and ^{40}Ca. The setup, similar to that previously used in ref. [3], consisted of an annular Si strip detector (16 rings x 16 sectors) covering the angular range from 167^{o} to 154^{o}, a ^{3}He gas target cell (50μgr/cm^{2}), and the FMA. The angular range covered by the Si detector in the CM system is 8^{o}-16^{o}, where the Δl=0 transfer cross sections are favored. Proton spectra for the systems studied are shown in Fig. 1. In each case, the beam current was kept at a level of about 200epA. The 0^{+} and 1^{+} states of interest are indicated from which we could measure both the ratio and absolute cross sections. The results agree with earlier experiments carried out in "normal kinematics". Compared to uncorrelated transfer processes, the cross section to the T=1 states appears to be enhanced with respect to the T=0 states consistent with the presence of T=1 *np* correlations.

We then proceeded with the radioactive ^{56}Ni beam experiment. The ^{56}Ni cone was produced at the IPNS driver. Unfortunately, the beam intensity on target turned out to be at least a factor of 10 less than our original estimate of 3x10^{5} /s and consequently we did not obtain enough data. Improvements in the Tandem injection and transmission are being considered and we plan to carry out this important measurement in the near future.

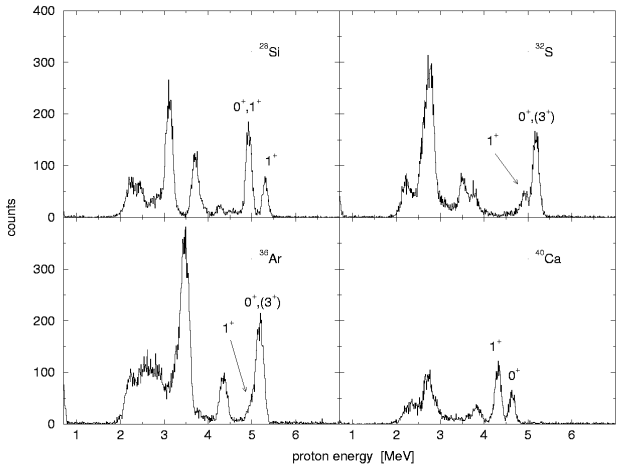

Fig. 1. Proton spectra in coincidence with the FMA, obtained for the different reactions.

References

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